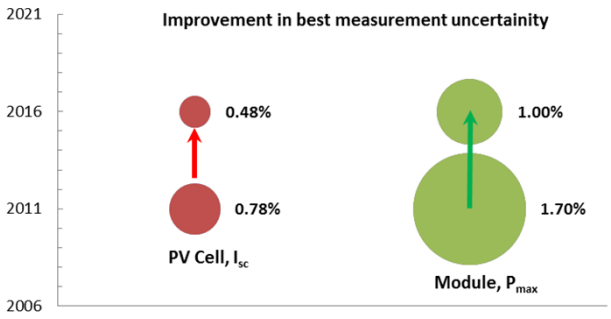
European Commission

Photovoltaics:
Precision Power Measurement for the Fastest Growing Renewable Energy Technology

Photovoltaic (PV) power systems are set to be one of our major sources of clean and sustainable energy in the future. Metrology for electrical performance of PV devices needs to keep pace with changing technology and market needs.

The JRC's European Solar Test Installation (ESTI) recently updated its ISO 17025 calibration accreditation and can now offer top precision electrical performance calibration for PV cells and modules.

ESTI European Solar Test Installation



Raising the bar for PV calibration precision

JRC scientists published new research[1] in 2015 showing that the uncertainty in measurement of power generation from a PV reference cell can be more than halved.. ESTI has updated its calibration procedures accordingly and in 2016 ACCREDIA[2] approved the new accreditation (LAT No 225). This includes a best-case value for reference cell secondary calibration of just under 0.5%., which is unique to our knowledge.

Impact

Photovoltaic solar panels are bought and sold on the basis of their power output under standard test conditions. Manufacturers include a margin (typically few percent) on this value to allow for small variations in manufacturing and measurement. Tightening this margin brings an economic benefit to them and to investors – no small matter for a module market worth over € 30 bn in 2016.

For researchers, reducing uncertainty increases the possibility to clearly identify the impact of new materials and processes.

PV Device	Parameters	2017 Best Uncertainty
Reference Cell (primary calibration)	**Current:**	**0.48 %**
Reference Cell (secondary calibration)	**Current:** **Voltage:** **Power:** **Efficiency:**	**0.48 %** **0.08 %** **0.85 %** **0.85 %**
Module (secondary calibration	**Current:** **Voltage:** **Power:** **Efficiency:**	**0.52 %** **0.22 %** **1.00 %** **1.00 %**

[1]) Metrologia, Volume 52, Number 5, p 646 (open access)
[2]) ACCREDIA (Ente Italiano di Accreditamento)

ESTI's new capability is available to researchers and to industry. We can provide:

- calibration of reference devices for EU national laboratories to disseminate best practice and traceability
- verification of electrical performance of PV technologies developed in EU co-funded programmes
- commercial calibrations for industry, focusing on new and innovative technologies.

Joint Research Centre

Technical Background

ESTI calibration measurements rely on a calibration chain ultimately traceable to the SI (Système International d'Unités) irradiance scale. The JRC has traditionally calibrated its primary reference devices against the instrument group maintained at the world radiometric centre in Davos, Switzerland.

Recent updates to the world radiometric reference values to take account of improved instrumentation prompted JRC scientists to re-analyse the data of their five primary reference cells (highly stable crystalline silicon devices). Rigorous analysis of the uncertainties resulted in the more accurate calibration values . The unique ESTI reference cell set made this possible, drawing from 20 years of calibration history, well controlled maintenance and regular stability checks, as well as collaboration with the world leading solar reference laboratories in Japan, USA and Europe.

Joint Research Centre

The Joint Research Centre (JRC) is the European Commission's science and knowledge service which employs scientists to carry out research in order to provide independent scientific advice and support to EU policy.

As part of its activities the JRC operates the European Solar Test Installation (ESTI) for assessing PV device performance at its site in Ispra, Italy. It's online tool PV-GIS provides free data on solar energy resource and potential PV electricity output for Europe and beyond.

The European Commission has a Type “A” Liaison with the International Electrotechnical Commission and ESTI contributes extensively to Technical Committee 82 (photovoltaics). For Cenelec, ESTI staff act as the Commission’s technical representative (non-voting) to the committees dealing with European norms for photovoltaics.

Facilities available at ESTI include:

Module Measurements
Steady state solar simulator (2 m x 2 m)
Pulse solar simulator (10 ms, 3m x 3m)
Long pulse solar simulator (100 ms)
Pulse solar simulator for spectral response
Pulse and steady state solar simulators for TCO
Natural sunlight (outdoor) facility
Energy yield/rating measurements (outdoor)
Laser scan (LBIC)
Electroluminescence
Pre-conditioning chamber (light and temperature)
Accelerated aging (damp heat, thermal cycling)

Cell Measurements
Steady state solar simulator
High intensity flash solar simulator
Spectral response (single/multi-junction devices)

For information on calibration please contact: JRC-ESTI-SERVICES@ec.europa.eu

We also welcome inquiries from researchers interested in using ESTI facilities

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ESTI on the JRC Science Hub:
https://ec.europa.eu/jrc/en/research-facility/european-solar-test-installation